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STUDIES ON THE CALIFORNIAN SPECIES OF STIPA (GRAMINEAE)[1]

DALVO M. DEDECCA

I. THE RATIO OF LEMMA TO PALEA LENGTH AS A TAXONOMIC CHARACTER

The genus *Stipa*, according to Hitchcock (1950), has in California nineteen species and four varieties—about one-half of the number of species reported for the entire United States. In addition to the taxonomic treatment given by Hitchcock, the Californian species have been studied cytologically by Stebbins and Love (1944), who have made most of the available chromosome counts of the species. There does not appear to be, incidentally, any evident correlation between chromosome number and the grouping of species indicated by other criteria.

In the course of morphological and anatomical investigations made by the author while studying the Californian species of *Stipa*, it was found that the ratio of the length of the lemma to that of the palea (hereafter expressed as L:P) was of significance. On the basis of this ratio, the Californian species may be divided into the following three groups:

GROUP 1	GROUP 2	GROUP 3
L:P less than 2.0	L:P 2.0–4.0	L:P more than 4.0
S. comata	*S. arida*	*S. cernua*
S. comata intermedia	*S. californica*	*S. lepida*
S. coronata	*S. columbiana*	*S. lepida Andersonii*
S. latiglumis	*S. columbiana Nelsoni*	*S. pulchra*
S. Lemmoni	*S. coronata*	
S. Lettermani	*S. coronata depauperata*	
S. pinetorum	*S. diegoensis*	
S. speciosa	*S. Elmeri*	
S. Stillmanii	*S. latiglumis*	
S. Thurberiana	*S. occidentalis*	
	S. pulchra	
	S. speciosa	
	S. Williamsii	

Table 1 shows the L:P ratio for each of the species and varieties listed above, as well as the most frequent value in each case. As indicated in figure 1, the division of the species and varieties into the three groups is not perfect because of the existence of a few cases of overlapping in values. Thus, *S. coronata*, *S. latiglumis*, and *S. speciosa* must be included both in groups 1 and 2.

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[1] Grateful acknowledgement is made to the Rockefeller Foundation for the fellowship which made possible the author's program of study at the University of California, Berkeley.

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TABLE 1. RATIO OF LEMMA OVER PALEA IN THE CALIFORNIAN SPECIES OF STIPA.

Species	Number of specimens studied	L:P	Most frequent values
S. arida Jones	17	2.0–2.7	2.4
S. californica Merr. & Dav.	44	2.0–3.2	2.4–2.5
S. cernua Steb. & Love	20	4.0–8.0	6.0–6.5
S. columbiana Macoun	33	2.2–3.2	2.5
S. columbiana var. *Nelsoni* Hitch.	4	2.2–3.0	2.8
S. comata Tr. & Rupr.	28	1.3–1.6	1.5
S. comata var. *intermedia* Scrib.	9	1.4–1.6	1.5
S. coronata Thurb.	46	1.6–2.2	1.8
S. coronata var. *depauperata* Hitch.	22	1.6–2.5	2.3
S. diegoensis Swallen	8	2.0–2.2	2.0
S. Elmeri Piper & Brodie	28	2.0–3.5	3.0
S. latiglumis Swallen	9	1.7–2.0	1.8
S. Lemmoni (Vasey) Scrib.	44	1.2–1.6	1.4
S. lepida Hitch.	21	4.1–6.0	5.0
S. lepida var. *Andersoni* Vasey	12	4.0–5.5	4.2
S. Lettermani Vasey	32	1.2–1.7	1.4–1.6
S. occidentalis Thurb.	57	2.0–3.5	2.3
S. pinetorum Jones	21	1.1–1.7	1.4
S. pulchra Hitch.	60	4.0–5.7	4.5
S. speciosa Tr. & Rupr.	57	1.5–3.3	2.5
S. Stillmanii Boland.	6	1.0–1.1	1.1
S. Thurberiana Piper	33	1.1–1.7	1.5
S. Williamsii Scrib.	6	2.5–3.0	3.0

Much more reliable, however, is the arrangement of the species into two groups, the former comprising those in which the L:P ratio is less than 4.0, and the latter consisting of those in which the L:P ratio is 4.0, or more than 4.0. Furthermore, this division corresponds perfectly with a division of the species into two classes based upon the type of inflorescence. As indicated by the following key, the combination of these two characters, supplemented by other characters which have been more commonly used to delineate species, makes possible a new arrangement of the Californian species of *Stipa*.

A. Panicle narrow, contracted or slender, sometimes more expanded; L:P ratio less than 4.0.
  B. Lemma densely appressed-villous, with white hairs 3–4 mm. long rising above the summit in a pappus-like crown.
    C. Lemma ca. 8 mm. long; awn 4–5 cm. long .... *S. coronata*
    CC. Lemma up to 6 mm. long; awn ca. 2 cm. long .... *S. pinetorum*
  BB. Lemma sparsely appressed-pubescent to glabrate, never villous with long hairs.
    D. Awns pubescent, most commonly plumose.
      E. First segment of the once-geniculate awn strongly plumose, the ascending hairs 5–8 mm. long .... *S. speciosa*
      EE. First segment of the awn conspicuously pubescent, generally plumose but the hairs 2 mm. long or less.
        F. Lemma bilobed at summit, the lobes extending into two lateral awns 2–3 mm. long on each side of the central awn .... *S. Stillmanii*
        FF. Lemma entire or only obscurely lobed at summit.
          G. Ligule hyaline, 3–6 mm. long .... *S. Thurberiana*

GG. Ligule opaque, minute, less than 3 mm. long.
H. Palea 4–5 mm. long .... *S. latiglumis*
HH. Palea up to 3 mm. long.
I. Sheaths glabrous.
J. Hairs on upper part of lemma longer than those below; hairs of awn rather short .... *S. californica*
JJ. Hairs of lemma uniformly short; hairs of awn rather long.......... *S. occidentalis*
II. Sheaths pubescent .... *S. Elmeri*
DD. Awns scabrous to nearly glabrous, rarely appressed-hispid, not plumose.
K. Mature lemma pale or becoming brownish, mostly more than 1 cm. long.......... *S. comata*
KK. Mature lemma yellowish, not more than 8 mm. long.
L. Lemma broad; first glume 5-nerved.......... *S. Lemmoni*
LL. Lemma narrow; first glume 3-nerved.
M. Palea much smaller than lemma, L:P 2.0–4.0; lemma short-hirsute throughout.
N. Culms densely pubescent below the nodes; palea 3–4 mm. long.......... *S. diegoensis*
NN. Culms glabrous below the nodes; palea 2.5 mm. long or less.
O. Awn 4–6 cm. long, obscurely geniculate, the terminal segment flexuous; lemma short-hirsute except near the glabrous apex.......... *S. arida*
OO. Awn usually less than 5 cm. long; if 4 cm. long, twice-geniculate, the terminal segment essentially straight.
P. Sheaths, at least the lowermost, pubescent .... *S. Williamsii*
PP. Sheaths glabrous .... *S. columbiana*
MM. Palea nearly equaling lemma, L:P less than 2.0; hairs at summit of lemma longer than those of the body .... *S. Lettermani*
AA. Panicle broad, open, loose, the branches spreading, L:P 4.0 or more than 4.0.
Q. Lemma less than 7 mm. long; awn up to 4 cm. long .... *S. lepida*
QQ. Lemma more than 7 mm. long; awn much more than 4 cm. long.
R. Lemma slender, cylindrical; middle culm leaves 1.2–2.4 mm. broad; foliage usually glaucous; awn slender, flexuous beyond the second bend, mostly 9–12 times the length of the lemma .... *S. cernua*
RR. Lemma fusiform; middle culm leaves 2.4–6 mm. broad; foliage usually green; awn stout and stiff, mostly 7–9 times as long as the lemma.... *S. pulchra*

II. THE OCCURRENCE OF STIPA LETTERMANI VASEY IN CALIFORNIA

Stipa Lettermani Vasey, a perennial grass 20–30 cm. tall producing culms in large tufts, has often been reported for California where it is stated to grow on open ground or in open woods at high altitudes. Its occurrence in the state is indicated by Hitchcock (1950), and the numerous Californian collections identified as this species by various authorities suggest that it is widespread in the state. *Stipa californica* Merr. & Davy, another perennial grass which has been differentiated from *S. Lettermani* primarily on the basis of differences in the pubescence of the awns, has been generally accepted to be widespread at lower altitudes than *S. Lettermani*.

On the basis of the L:P ratio already discussed as well as other morphological and anatomical data gathered by the author during the course of his study of the Californian species of *Stipa*, it has been possible to clarify

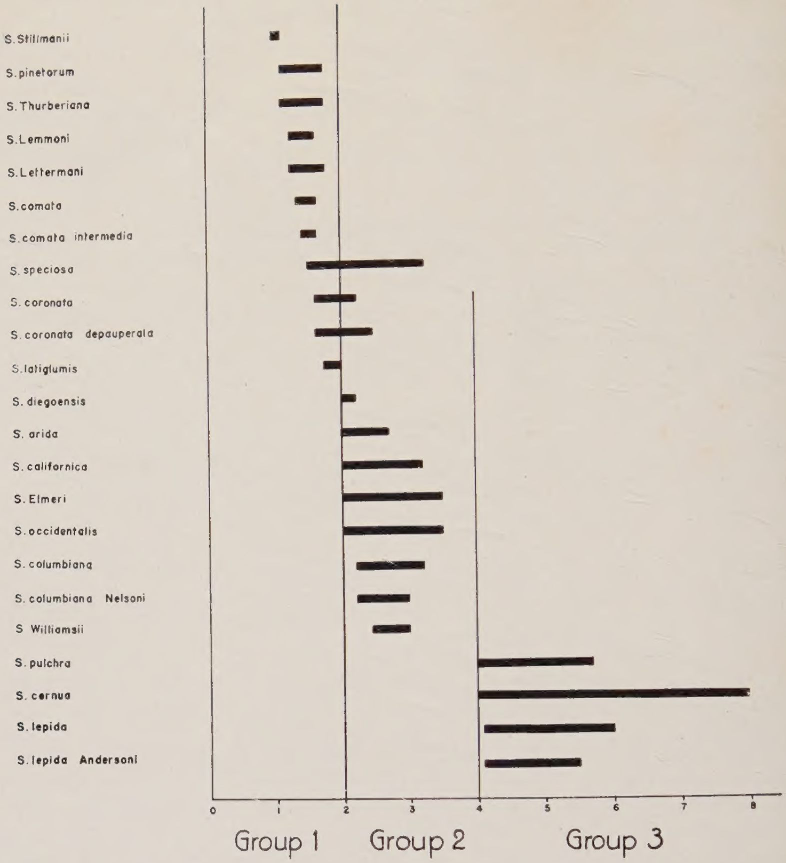


FIG. 1. The ratio of lemma to palea length in the Californian species of *Stipa*.

our concept of these two species. Although a comparison of the morphological characters of *S. Lettermani* and *S. californica* suggests a general similarity on such characters as panicle type, texture of the glumes, pubescence of the lemma, and the length of the callus, a number of diagnostic characters (table 2) are present. Of these, the highly specific and extremely different L:P ratio is outstanding.

In habit, *S. Lettermani* appears to be relatively similar throughout its range being of medium height. *Stipa californica* is much more variable; in altitudes from 4,000 to 6,000 feet it grows in open pine woods and is a robust plant with long leaves and culms 80–100 cm. high, and at higher altitudes there is a gradual transition to dwarfed and subalpine types growing in open places. These have much shorter leaves and culms which may not exceed 30–40 cm. It is this dwarf type which is confused with *S. Lettermani*.

Stipa Lettermani, *S. californica*, and *S. Elmeri* (the last differing sharply in other characters and hence not confusable with the other two) are the only species of the genus in western North America characterized by possessing two kinds of hairs on the lemma, a feature which has been employed to distinguish the two former species from such close relatives as *S. occidentalis* and *S. columbiana*. Thus, in *S. Lettermani* and in *S. californica*, the body of the lemma (including the callus) is covered with sparse, stiff, white hairs, which increase in length toward the apex and culminate in a conspicuous terminal brush of longer hairs. The two species differ in lemma pubescence, however, for in *S. californica* either the hairs on the body of the lemma or the apical ones are longer and thicker than those of *S. Lettermani* (table 2).

TABLE 2. COMPARISON OF PRINCIPAL DIAGNOSTIC CHARACTERISTICS OF STIPA LETTERMANI AND STIPA CALIFORNICA.

Structure	*Stipa Lettermani*	*Stipa californica*
Leaves	Green, slender, involute, 20–30 cm. long, 2.0–2.2 mm. broad, throughout culms	Green or somewhat glaucous, blades flat, with tendency to become involute, 10–15 cm. long, 1.5–4.0 mm. broad
Size of glumes	Glumes equal, 7.0–9.0 mm. long	Glumes slightly unequal, upper 8–13 mm. long, lower 7.5–12.0 mm. long, sometimes equal
Length of lemma	4.5–6.0 mm.	5.0–7.5 mm.
Width of lemma (unrolled)	1.6–2.0 mm.	1.9–2.2 mm.
Hairs at apex of lemma	1.3–1.7 mm. long, 10–19μ thick	1.5–2.2 mm. long, 20–30μ thick
Hairs on body of lemma	0.8–1.3 mm. long, 8–16μ thick	0.4–0.6 mm. long, 10–18μ thick
Lobes of lemma	0.8–1.0 mm. long	0.5–0.7 mm. long
Length of palea	3.5–4.5 mm.	2.0–3.0 mm.
L:P ratio	1.2–1.7	2.0–3.2
Pubescence of awn	Scabrous below first bend, glabrous on other two segments	First and second segments conspicuously or weakly pubescent, third segment scabrous

The pubescence of the awns may be considered the most reliable of the traditional criteria for distinguishing the two species. In *S. Lettermani* the first two segments of the awns are glabrous, and the third segment scabrous; in *S. californica* the first two segments are described as conspicuously plumose, the third scabrous. The chief confusion has occurred in the reference to *S. Lettermani* of plants which show a manifest pubescence on the first two segments, but in which the awn is not conspicuously plumose. In all instances, these plants actually belong to *S. californica*, the two first awn-segments of *S. Lettermani* being truly glabrous or essentially so.

A more reliable and easily employed criterion for separating the two species is provided by the absolute and comparative length of the palea. Measurements of some thirty-five collections of *S. californica* from throughout its range have shown the palea to vary in length from 2.0–3.0 (—3.2) mm., that is, the palea is rather short in comparison with the lemma. In *S. Lettermani,* on the other hand, the usual length of the palea is (3.0–) 3.5–4.5 (–5.0) mm., or nearly as long as the lemma. Thus, the L:P ratio (2.0–3.2 in *S. californica,* 1.2–1.7 in *S. Lettermani*) proves to be an excellent character for differentiating these two species, and has valuable applications elsewhere in the genus.

The following key summarizes the characters discussed above which serve to differentiate these two species of *Stipa.*

Leaves filiform, strongly involute; apical hairs of lemma 1.3–1.7 mm. long, 10–19μ thick; awns glabrous or essentially so; L:P ratio 1.2–1.7 .... *S. Lettermani*

Leaves broader, nearly plane, often becoming involute in dried specimens; apical hairs of lemma 1.5–2.2 mm. long, 20–30μ thick; awns conspicuously pubescent (plumose); L:P ratio 2.0–3.2 .... *S. californica*

A re-examination of a series of specimens from the Intermountain Herbarium of the Utah State Agricultural College, Pomona College, the United States National Herbarium, and the University of California Herbarium indicates that only a single collection of *Stipa* in California is properly referable to *Stipa Lettermani.* This was collected in Bear Valley, San Bernardino County (*H. S. Yates 6617,* UC). All other reports of the species in the state, including collections from Alpine, Butte, Humboldt, Mariposa, Modoc, Mono, Shasta, Tulare, and Tuolumne counties, are based upon misidentifications.

Stebbins and Love (1944), in their cytological study of Californian forage grasses, have mentioned a chromosome count of *S. Lettermani,* based upon a collection made in Little Last Chance Valley, Plumas County (*Stebbins 2920*). On the basis of the present evidence, this collection is not *S. Lettermani,* and still more interesting, because of its chromosome number, which is 2n=68, it is not referable to *S. californica* either. Since the chromosome number of *S. Lettermani* is 2n=32 (Stebbins, unpubl.), the collection from Plumas County apparently represents an undescribed polyploid related to *S. californica, S. Lettermani,* and *S. occidentalis.*

III. EPIDERMAL CHARACTERS IN THE CALIFORNIAN SPECIES OF STIPA

The epidermal cells of the Gramineae were first given serious study by Grob (1896–1897), who called attention to the significance which their characteristics might offer for taxonomic purposes. It was Prat (1932), however, who thoroughly investigated the epidermis and emphasized its features for the characterization of genera and larger groups. Thus, on the basis of epidermal characters, the Gramineae were divided into two main categories, the panicoid and the festucoid. The fact that these two major categories could be progressively subdivided into smaller and smaller groups by employing the same kind of criteria, has led some authors to consider the nature of the leaf epidermis as important in determining phylogenetic relationships. The Russian cytologist Avdulov (1931), basing his work upon karyological data, developed a new scheme of arrangement for the tribes of grasses, and supplemented his system with the evidence derived from epidermal cells as previously reported by Grob. More recently, Covas (1949) has successfully utilized the epidermis in his study of *Hordeum,* and so did de Wet (1952) in his investigation on *Danthonia* and related genera. As proved to be the case with the L:P ratio, epidermal features have shown their usefulness taxonomically when applied to the Californian species of *Stipa.*

MATERIAL AND METHOD. Only herbarium material was used in studying the epidermal cells of the Californian species of *Stipa.* Two slides were prepared for each species and variety, utilizing whenever possible collections as remote from each other geographically as feasible. All observations were made on the abaxial (lower) epidermis obtained from leaves produced at the second internode. The leaves were softened by being placed in boiling water for about ten minutes, and were then transferred to the stage of a dissecting microscope and placed with the axial (upper) epidermis uppermost. The upper epidermis and mesophyll tissues were then gently scraped away with a sharp scalpel, leaving only the lower epidermis. The lower epidermis was cut into small pieces, mounted with the lower surface uppermost on a slide in lactophenol, and covered with a cover glass.

TYPES OF EPIDERMAL CELLS. *Stipa* is, according to Avdulov (1931) and Prat (1932), to be included in the Phragmitiformis group of grasses, which is a mixed assemblage of various affinities. The epidermis, in members of this group, however, is festucoid, being characterized by the possession of simple, rounded or elongate, siliceous cells; the minute hairs, if present, are never two-celled. The epidermal cells with important differential characters in *Stipa* may be classified as below.

a. **Long cells.** These are several times as long as broad, are the most numerous element, and comprise the bulk of the epidermis. They show characters of taxonomic value in the variation both in thickness and in degree of undulation of the cell walls, permitting the distinction of three categories of each of these characters.

The walls may be of great thickness as in *S. comata* (fig. 2), of moderate thickness as in *S. Lettermani* (fig. 3), or of slight thickness as in *S. californica* (fig. 4). As to degree of undulation, the walls may be grossly undulate as in *S. comata* (fig. 2), moderately undulate as in *S. californica* (fig. 4), or only slightly undulate as in *S. diegoensis* (fig. 5).

b. **Barb or point cells.** These cells are characterized by terminating in a hair-like upward prolongation (readily visible under the high power objective). They occur either over or between the veins, although both distributions may occur in the same epidermis, as in *S. californica* (fig. 4). In addition, the intervenous point cells may have either a sharp or a blunt prolongation.

c. **Siliceous cells.** These characteristic cells, distinguished by their high silica content, are divisible into three more or less distinct groups:

Type 1, couple cells. These are composed of two unequal cells, a siliceous cell combined with a suberous one, the smaller showing refringent points which indicate regions in which no silica was deposited (Prat 1932). The couple cells may occur between the veins only, as in *S. californica* (fig. 4), or both between and over the veins, as in *S. comata* (fig. 2).

Type 2, dumbbell or cross-shaped cells. These cells, which Prat (1932) considers as panicoid, are arranged with their long axes parallel to the leaf axis, over the veins. They occur in all species studied except *S. Stillmanii.*

Type 3. These cells are more elongate than the last, have three or more constrictions, and occur only over the veins. They have been found in seven of the nineteen species studied. *Stipa Lettermani* exhibits this type of cell (fig. 3).

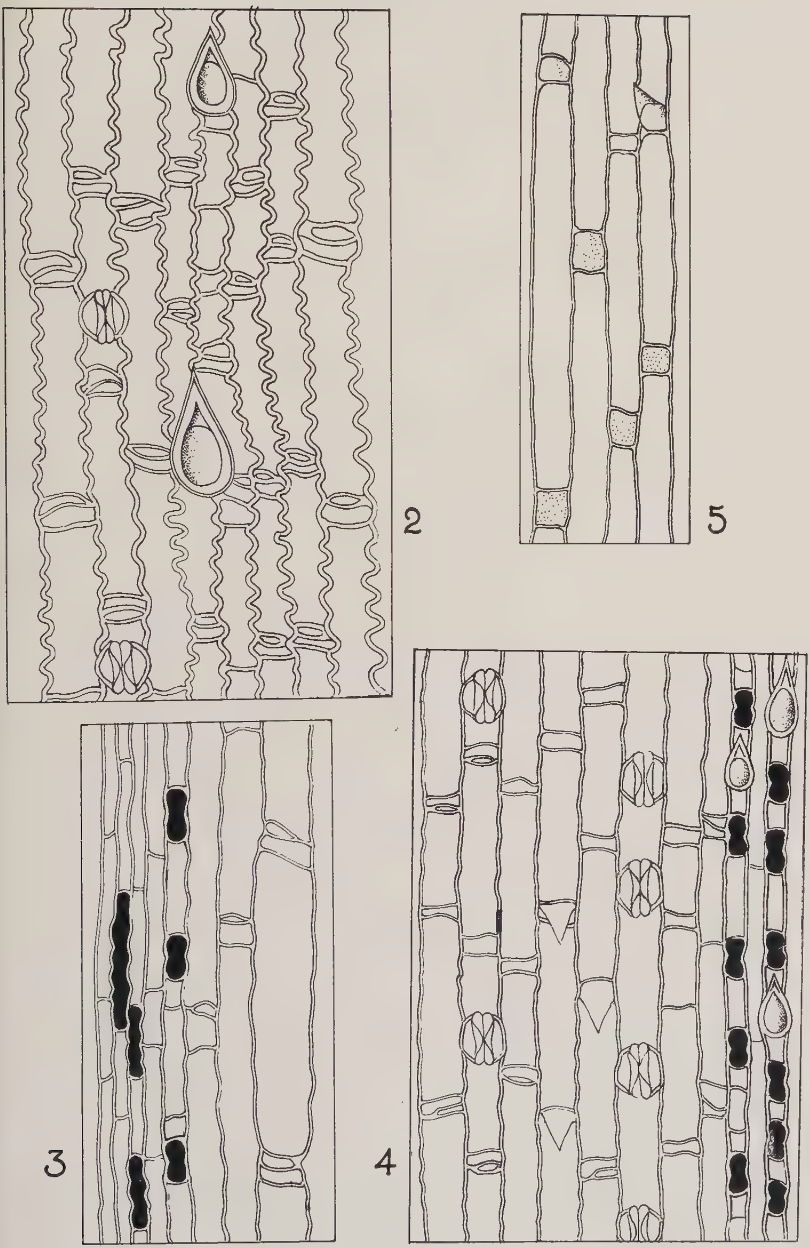
d. **Isolated suberized cells.** These cells are distinguishable by their square shape and darker color, staining red with Sudan IV. They have been found in thirteen of the nineteen species investigated. *Stipa diegoensis* exhibits this type of cell (fig. 5).

e. **Stomata.** Although it is recognized that the stomata may vary in size and shape, only their presence or absence in the abaxial epidermis and their arrangement were taken into consideration in the present study. For the sake of simplicity, the species studied were divided into three groups on stomatal features, as follows: stomata absent, as in *S. Lettermani* (fig. 3); one stomatal row present in some intervenous areas, as in *S. lepida;* two or more stomatal rows present in some or all intervenous areas, as in *S. californica* (fig. 4).

Table 3 presents a general picture of the various types of epidermal cells found in the Californian species and varieties of *Stipa*. As may be seen, these structures readily permit the differentiation of the individual taxa from each other in most instances. Because of the difficulty of observing such anatomical or cytological features, their inclusion in a key for identification appears to be scarcely practicable, although they are useful for more detailed analysis. The following example of *S. Lettermani*

Explanation of Figures 2–5.

Figs. 2–5. Types of epidermal cells. Fig. 2. *Stipa comata,* showing great thickness and gross undulation of the long cell walls; couple cells both between and over the veins, ×950 (*Kennedy 81*). Fig. 3. *Stipa Lettermani,* showing moderate thickness of the long cell walls; siliceous cells Type 2 and Type 3 in black, ×950 (*Yates 6617*). Fig. 4. *Stipa californica,* showing slight thickness and moderate undulation of the long walls, point cells both between and over the veins, siliceous cells Type 2 in black, and two rows of stomatal cells, ×950 (*Stebbins 2942*). Fig. 5. *Stipa diegoensis,* showing slight undulation of the long cell walls, and suberized cells, ×950 (*Gander 5778*).



FIGS. 2–5. Types of epidermal cells in *Stipa*.

Species	Long Cells						Barb or Point Cells					Siliceous Cells						Isolated Suberized Cells		Stomata		
	Wall Thickness			Wall Undulation			Over the Veins		Between the Veins			Type I —couples—		Type II		Type III						
	G	M	S	G	M	S	Abs	Pres.	Abs.	Blunt	Sharp	Betw. veins	Betw.+ over veins	Abs.	Pres.	Abs.	Pres.	Abs.	Pres	Abs.	1 row in some intervenous areas	2 or more rows in some or all intervenous areas
S. pinetorum	x			x				x			x	x			x	x		x		x		
S. Thurberiana		x			x			x			x	x			x	x			x	x		
S. Lemmoni		x			x			x	x				x		x	x		x		x		
S. lepida		x			x			x			x	x			x	x			x		x	
S. lepida Andersoni		x			x			x			x	x			x	x			x		x	
S. occidentalis		x			x			x	x			x			x		x	x		x		
S. californica			x		x			x			x	x			x		x		x			x
S. Elmeri			x		x			x			x	x			x		x		x		x	
S. columbiana		x			x			x	x			x			x		x	x		x		
S. columbiana Nelsoni		x			x		x		x			x			x		x	x				x
S. Williamsii			x		x			x	x				x		x	x		x		x		
S. arida	x					x		x	x			x			x	x			x	x		
S. diegoensis			x			x		x			x	x			x		x		x			x
S. latiglumis		x				x		x	x				x		x	x			x	x		
S. Stillmanii	x				x			x			x		x	x		x			x			x
S. coronata	x					x		x	x				x		x	x			x	x		
S. coronata depauperata	x				x		x		x				x		x	x		x		x		
S. comata	x			x				x			x		x		x	x			x			x
S. comata intermedia		x				x		x	x			x			x		x	x				x
S. speciosa	x			x				x			x		x		x	x			x	x		
S. pulchra		x				x		x			x	x			x	x			x			x
S. Lettermani		x			x			x	x			x			x		x		x	x		
S. cernua		x			x			x		x			x		x	x			x			x

TABLE 3. OCCURRENCE AND ARRANGEMENT OF EPIDERMAL CELLS IN CALIFORNIA SPECIES OF STIPA.

and *S. californica* shows clearly, however, how entities commonly confused on the basis of grosser morphological characters may be readily separated on features of the epidermis. Thus, *S. californica* has the long cells thin-walled, the intervenous point cells with a sharp prolongation, intervenous siliceous cells of Type 1 (couple cells), and two stomatal rows in some intervenous areas. *Stipa Lettermani,* on the other hand, has long cells with walls of intermediate thickness, and completely lacks intervenous point cells and stomata on the abaxial epidermis.

The study of the data shown in Table 3 offers a number of other interesting points. Thus, each species has a distinctive combination of epidermal characters. The closest resemblance was shown by *S. californica* and *S. Elmeri,* which are known to be closely similar in their gross morphology and habit. On the basis of epidermal cells, these two species differ only in the distribution and arrangement of the stomata. This fact, however, cannot be generalized, for *S. occidentalis* and *S. Elmeri,* which are also very similar morphologically, have very different combinations of epidermal characters.

On the other hand, *S. lepida* and *S. Thurberiana* are quite different as to gross morphology and habit, but in respect to epidermal characters are very similar, being distinguished only by the arrangement of the stomata.

In summary it can be said that although the epidermal characters have some taxonomic significance the evidence they present for relationship among species may very often be at variance with evidence provided by gross morphology in respect to affinities in the same group of species.

ACKNOWLEDGMENTS

The author wishes to express his appreciation to Dr. G. L. Stebbins, Jr., and to Dr. Lincoln Constance, under whose direction this work and all of the author's program of study at the University of California, Berkeley, was carried out. The author is indebted to the curators of the following herbaria for the loan of material: United States National Herbarium, Herbarium of the University of California, Herbarium of Pomona College, and Intermountain Herbarium of Utah State Agricultural College.

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A NEW SPECIES OF QUERCUS IN ARIZONA

Cornelius H. Muller

In 1948 there came to my attention a specimen collected in the Ajo Mountains of Pima County, Arizona, which was identified with considerable misgiving as *Quercus turbinella* Greene. Recently two series of collections from the same locality were referred to me by Dr. John M. Tucker of the University of California (Davis), who had requested Dr. K. F. Parker of the University of Arizona to obtain the specimens for him. Dr. Tucker furthermore furnished me with notes derived from specimens at the Pomona College Herbarium indicating a similar oak in the Castle Dome Mountains and the Kofa (S.H.) Mountains of Yuma County, Arizona.

A close examination of the Ajo Mountain material suggested kinship with the series *Glaucoideae* Trel. of Mexico (to which *Q. hinckleyi* Mull. of Texas had been referred). Its distinctness from *Q. turbinella* was apparent. Two joint field studies with Dr. Tucker in the Ajo Mountains and subsequent visits to the Castle Dome and Kofa Mountains confirmed in my mind the differences between *Q. turbinella* and the population of the Ajo Mountains. However, certain features of the Ajo population (notably the prominent spinose teeth of the leaf margins) are so strikingly at variance with the series *Glaucoideae* that the description of a new series is required.

Quercus ser. **Relictae** ser. nov. Frutices vel arbores, ramuli gracili glabri vel tomentosi pruinosi, gemmae rotundae minutae, folia sempervirentia coriacea glauca glabra vel sparse pubescentia aristato-dentata, petioli brevi, fructus annuus parvus pedunculatus, cupula squamis levis crassis, glans oblonga vel ovoidea ad basim solum cincta.

Rhizomatous shrubs or low trees with slender glabrous or pubescent pruinose twigs and minute buds and apically persistent stipules; leaves small or minute, glabrous or nearly so and strikingly glaucous, microscopically papillose beneath, prominently toothed and attenuately spinose; fruit small, the shallow cups with small scales, the oblong to ovoid acorns glabrous or apically pubescent and included at the base only.

Desert mountains of the southwestern United States and possibly adjacent Mexico. Includes *Q. ajoensis* sp. nov. (the type) and *Q. hinckleyi* Mull. (Contr. Texas Research Found. 1: 40, pl. 11. 1951). The *Relictae* are closely related to the *Glaucoideae*, and especially to *Q. perpallida* Trel. of that series in which also the lower leaf epidermis is papillose but in which the teeth are not spinose.

Quercus ajoensis sp. nov. Arbor mediocris vel frutex, ramuli 1–2 mm. crassi sparse brevi-stellato-pubescentes glabrati pruinosi, gemmae 1–1.5 mm. longae ovoidae vel rotundae, folia sempervirentia coriacea ovata vel lanceolata 1.5–3.5 cm. longa 1–2 cm. lata apice acuta basi cordata vel rotundata utrinque 5- vel 6-attentuato-spinoso-dentata glauca et glabra

vel rare subtus sparse fulvo-puberulenta et ad basim costis utrinque stellato-pubescentia, lamina subtus minuto-papillosa, petioli 3–4 mm. longi sparse stellato-pubescentes, fructus annuus brevi- vel longi-pedunculatus, cupula 6–8 vel 10 mm. lata 3–4 mm. alta squamis appressis, glans 1.25–1.5 cm. longa 0.5–0.7 cm. lata oblonga vel angusto-ovoidea glabra apicem exceptis ad basim solum cincta.

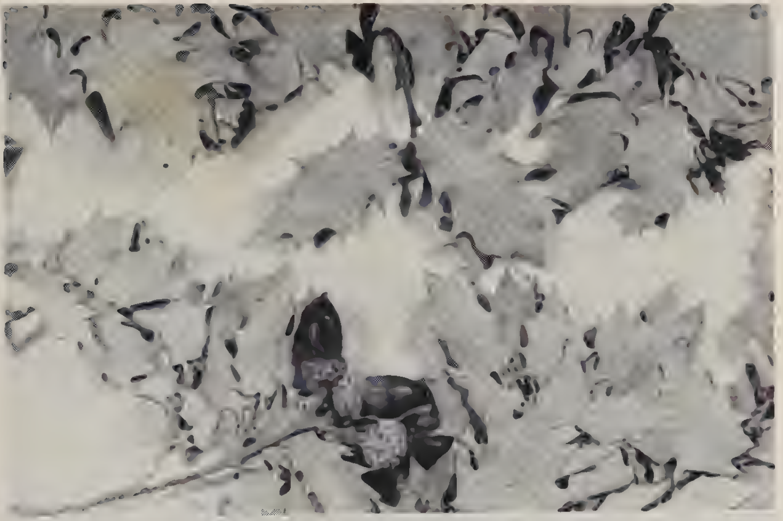
Small trees or shrubs (along intermittent waterways and on high north-facing slopes), reaching 10 m. in height with trunk diameters to 6 dm. (usually smaller); trunks branched at or near the ground level; branches ascending or broadly spreading, the bark thin, scaly (almost flaking) or furrowed, light gray. Twigs ca. 1 (rarely 2) mm. in diameter, light brown and usually inconspicuously short-stellate-pubescent, rarely conspicuously gray-tomentulose, glabrate or the pubescence variously persistent, gray in age or mottled with russet. Buds very inconspicuous, 1 to 1.5 mm. long, ovoid or irregularly rounded, brown or russet, glabrous or the outer scales lanate with short simple hairs; the stipules caducous, but persistent about the terminal bud, ca. 3 mm. long, ligulate, pubescent. Leaves evergreen, persisting 1 or 2 seasons, rather coriaceous, ovate to narrowly ovate or rarely lanceolate, 1 or usually 1.5 to 3.5 or rarely 5 cm. long, 0.5 or usually 1 to 2 or sometimes 3 cm. broad, apices acute or rarely obtuse (except the setaceous apical tooth), bases cordate or rarely rounded, each side with 5 or 6 (sometimes more or fewer) strikingly long-attenuate spinose-aristate teeth, upper surface glaucous green, glabrous or sparingly stellate-pubescent along the midrib, lower surface waxy glaucous, the epidermis microscopically papillose, glabrous or sparsely stellate-pubescent along the midrib or sometimes minutely and sparsely golden-puberulent on the lamina, margins crisped between the teeth or sometimes flat, prominently cartilaginous; veins 5 to 8 on each side, as many as the teeth and terminating in them or with prominently branching intermediates, raised on both surfaces but more prominently so beneath; petioles 2 to usually 3 or 4 mm. long, slender, reddish (especially beneath at the base) or merely greenish-white or yellowish throughout, stellate-pubescent like the twigs or more sparsely so. Staminate catkins 2 to usually 4 cm. long, rather loosely flowered on a tomentulose peduncle, the 4 to 6 anthers exserted from the sparsely pubescent and ciliate perianth. Pistillate catkins 1.5 to 2.5 or even 5 to 7 cm. long, 2 to 4 flowers variously scattered or terminally grouped on a sparingly stellate-pubescent or nearly glabrous slender peduncle. Fruit annual, solitary or paired on peduncles 3 to 5 or more cm. long (or as short as 0.5 cm.); cups thin, 6 to 8 or rarely 10 mm. broad, 3 to 4 mm. high, shallowly cup-shaped, the scales with appressed glabrous brown subligulate apices, the bases moderately thickened and tan-pubescent or rarely densely gray-tomentose; acorns 1.25 to 1.5 cm. long, 0.5 to 0.7 (rarely 0.9) cm. broad, oblong to narrowly ovoid, apically somewhat narrowed or pointed, glabrous except for the dense apical tomentulum about the persistent styles, included at the base only.

ARIZONA. Pima County, Organ Pipe Cactus National Monument, Ajo Mountains: waterway of Arch Canyon, just opposite and north of Santa Rosa Mountain, elevation 3,200 feet, April 27, 1953, *Muller* and *Tucker 9547, 9548*; just opposite and south of The Spire, elevation 2500 feet, April 27, 1953, *Muller* and *Tucker 9549, 9550*; along wash at elbow of south fork of Alamo Canyon, elevation 2800 feet, April 27, 1953, *Muller* and *Tucker 9535–9539;* north-facing canyon wall above east fork of south fork of Alamo Canyon, elevation 3200 feet, April 27, 1953, *Muller* and *Tucker 9540–9543*; north-facing canyon near head of south fork of Alamo Canyon, elevation 3500 feet, April 27, 1953, *Muller* and *Tucker 9544, 9545*; open, grassy north-facing slope in Alamo Canyon just below summit of ridge adjoining Arch Canyon, elevation 4000 feet, April 27, 1953, *Muller* and *Tucker 9546;* main (south) fork of Alamo Canyon (between 2375 and 2675 feet elevation) in sparse streamside woodland of *Forestiera, Simmondsia, Juniperus, Celtis, Vauquelinia, Acacia,* and *Prosopis* in the otherwise openly shrubby mountains, August 15, 1952, *Muller* and *Tucker 9518, 9519* (type, in the Muller Herbarium at Santa Barbara and widely distributed), *9520–9525*; April 17, 1952, *Parker 7998, 8002, 8003, 8010, 8011*; October 7, 1951, *Parker* and *Lowe 7726–7729, 7732, 7733;* May 21, 1947, *Phillips s. n.*

In addition to the specimens cited above, a series comprising a mass collection was taken from lower Alamo Canyon August 15, 1952 (*Tucker* and *Muller 2436–1* to *2436–36*).

Quercus ajoensis is abundantly distinct from *Q. hinckleyi* whose low rhizomatous shrub habit and smaller leaves with fewer teeth clearly set it off. Presumably, both species have suffered geologically recent restriction of range incident to the general dessication of the region since the last pluvial period (whence the serial name, *Relictae*). A very real practical difficulty exists, however, in drawing a distinction between *Q. ajoensis* and *Q. turbinella.* This involves no legitimate question concerning the specific distinctness of the two, but rather arises from (1) the occurrence of intermediates (presumably of hybrid origin) in the mountains of Yuma County, lying more or less between the ranges of *Q. ajoensis* and *Q. turbinella,* and from (2) the unmistakable presence of *Q. turbinella* characters in a few individuals at low elevations in the Alamo Canyon population itself. The following specimens were examined from Yuma County, Arizona. Castle Dome Mountains: about 36 miles south of Quartzite, south fork of canyon above Horse Tanks, about 1800 feet elevation, August 16, 1952, *Muller 9526–9531.* Kofa (S.H.) Mountains: about 28 miles south of Quartzite, Palm Canyon, about 2500 feet elevation, August 16, 1952, *Muller 9532–9534*; September 5, 1952, *Tucker 2616–1* to *2616–11*; at the head of Palm Canyon, April 29, 1953, *Tucker* and *Muller 2641–1* to *2641–10*; middle Palm Canyon, April 29, 1953, *Tucker* and *Muller 2642–1* to *2642–5.*

In the canyon above Horse Tanks in the Castle Dome Mountains, and 8 miles north in Palm Canyon in the Kofa Mountains, there grow small



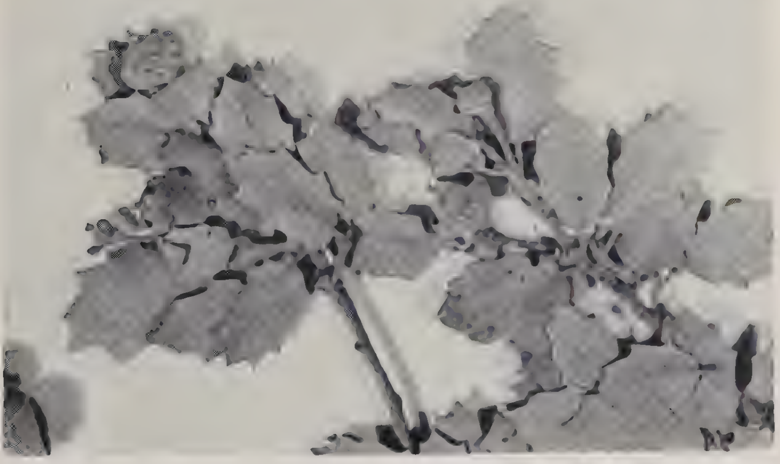


FIG. 1 (top). *Quercus ajoensis* Mull., *Muller* and *Tucker 9519,* the type collection from the Ajo Mountains, Arizona. FIG. 2 (bottom). *Quercus turbinella* Greene, *Clokey 7888,* from the Charleston Mountains, Nevada.

populations (about 15 to 100 trees) of relatively uniform intermediacy between *Q. ajoensis* and *Q. turbinella*. In these the long spinose-aristate teeth and waxy glaucous leaf surfaces of *Q. ajoensis* are usually but variously combined with the stellate pubescence of the leaf surfaces, the yellow glandular puberulence of the lower surface, increased gray stellate tomentum of twigs and petioles, and the broader and more tomentose cups with broader acorns which are characteristic of *Q. turbinella*. From a cursory observation of general habit and gross appearance of the leaves, one would be inclined to refer these individuals to *Q. ajoensis*. However, upon careful examination, one is forced to the conclusion that *Q. turbinella* characters predominate in both of these small populations. In fact, some specimens (notably *Muller 9529* in the Castle Dome area and *Tucker* and *Muller 2641–3* in the Kofa Mountains) are almost typical *Q. turbinella*.

Dr. A. R. Phillips reported (verbal communication to Dr. Tucker) the presence of typical *Q. turbinella* on the ridge tops at the head of Alamo Canyon in the Ajo Mountains at about 4000 feet elevation. Phillips and Pulich (Condor 50:271. 1948) refer to this as "true scrub oak." However, no specimens of this population were taken prior to *Muller* and *Tucker 9544* and *9546* which proved to be shrub forms of pure *Q. ajoensis*. Seedlings (*Muller and Tucker 9543*) occur abundantly beneath parent trees on the high north-facing canyon walls in the Ajo Mountains. They reveal an extraordinary uniformity with the mature forms and no significant juvenile characters. The occasional presence in the lower Alamo Canyon population in the Ajo Mountains of golden puberulence on the lower leaf surface, of broad and densely tomentose cups, and of increased twig tomentum suggests a very dilute hybridity with *Q. turbinella*. In fact, the type of *Q. ajoensis* (*Muller* and *Tucker 9519*) exhibits some of these characters minutely. This, however, is definitely not of the order of intermediacy exhibited by the Yuma County population where *Q. ajoensis* as such does not occur. The biological situation revealed by these several populations will be elaborated in a separate, non-taxonomic paper.

Although taxonomists have for many decades regarded the occurrence of numerous intermediates in a given situation as disproof of the existence of more than one species, I submit that in this case the presence of intermediates may be interpreted as strengthening the evidence that two species are indeed involved. Were *Q. ajoensis* not abundantly different from *Q. turbinella,* its introgression of the Yuma County populations could not have made them so obviously different from typical *Q. turbinella* of farther north. Although *Q. ajoensis* is now nearing extinction, the only known population being that in the Ajo Mountains, its striking characters and the marked effect of these upon the adjacent populations of *Q. turbinella* are ample proof of its evolutionary status.

The recognition as species in the genus *Quercus* of morphologically well differentiated taxa, so long as some parts of their populations remain pure, is as justified in my opinion as is the recognition as species of forms nearing extinction through influences other than hybridization. I am aware, of course, that some workers still insist that hybridization (actual or potential) with the production of fertile offspring is itself disproof of specific distinctness. This criterion, if rigidly applied to American *Quercus,* would probably reduce that multitudinous and extremely diverse assemblage to the ridiculous extreme of three "species", one for each of the subgenera.

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THE ALLOPOLYPLOID STIPA LATIGLUMIS[1]

Richard W. Pohl

Stipa latiglumis Swallen is a rare endemic Californian species described originally by Swallen (1933) from Yosemite Valley. It is a tufted perennial, resembling in its gross morphology such common species as *S. californica* Merr. & Davy and *S. elmeri* Piper & Brodie. Like these two species, it has pubescent lemmas which have the hairs markedly longer at the summit, and awns which bear spreading or ascending hairs on the basal twisted segment. From the former species, it differs in having puberulent sheaths, and from both species by its rather wide glumes, as indicated by the specific epithet.

Stipa latiglumis has been collected in Yosemite Valley a number of times and is apparently not rare there. It is also known from the Sierra Nevada of Fresno County and from Mount San Jacinto in Riverside County. A list of all known collection localities is given at the end of this paper. In Yosemite Valley, *S. latiglumis* grows in scattered clumps on sandy or rocky soil at the foot of talus slopes at about 4,000 feet elevation, in mixed stands of oaks and coniferous trees. *Stipa elmeri* grows with it, but tends to occupy the sandy alluvial soils of the valley floor. *Stipa lemmonii* occurs on the talus above the valley floor. Thus *S. latiglumis* occupies a habitat somewhat intermediate between those of the other two species.

In the amount and length of foliar pubescence, width of leaf blades, number of ribs on the adaxial leaf surface, and shape of the floret, *S. latiglumis* is intermediate between *S. elmeri* and *S. lemmonii.* In other traits, *S. latiglumis* resembles either of the latter two species, as is shown in Table 1 and Figure 4. The only exceptions are in the length of ligule and length of lemma, in which *S. latiglumis* exceeds both of its parents. The high degree of morphological intermediacy and the intermediate habitat suggested that *S. latiglumis* might be of hybrid derivation from these two species.

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[1] Journal paper No. J–2360 of the Iowa Agricultural Experiment Station, Ames, Iowa. Project No. 1136.

TABLE 1. MORPHOLOGICAL CHARACTERISTICS OF STIPA ELMERI, S. LATIGLUMIS, AND S. LEMMONII

CHARACTERISTICS	SPECIES		
	S. elmeri	*S. latiglumis*	*S. lemmonii*
Length of hairs on lowermost sheath (mm.)	0.7[1] 0.5–0.9	0.2 0.2–0.3	0.0
Length of ligule of lowermost culm leaf (mm.)	0.3 0.0–0.5	1.1 0.5–1.8	1.1 0.7–1.6
Length of ligule of uppermost culm leaf (mm.)	0.6 0.3–1.0	2.1 1.3–2.8	1.5 1.3–2.5
Pubescence of leaf blades adaxial surface/abaxial surface	hirsute/hirsute	puberulent/glabrous	puberulent/glabrous
Width of lowermost culm blade (mm.) (From living specimens)	3.6–6.5	3.4–3.9	1.5
Cross-sectional shape of blade	flat	flat	involute
Number of ribs on adaxial leaf surface (From living specimens)	13–16	9–11	5–7
Number of nerves on first glume	3	3	5
Folded width of first glume (mm.)	1.0 0.7–1.1	1.6 1.3–1.9	1.6 1.2–1.8
Length of lemma (mm.)	7.3 6.5–8.0	8.2 7.5–9.0	6.1 5.5–8.0
Width of lemma (mm.)	0.8 0.8–1.0	1.2 1.0–1.5	1.2 1.0–1.4
Ratio of lemma length/lemma width	8.5 8.0–9.3	7.1 5.7–8.3	5.1 4.6–5.5
Length of hairs on basal awn segment (mm.)	1.0 0.7–1.1	1.0 0.5–1.3	less than 0.1

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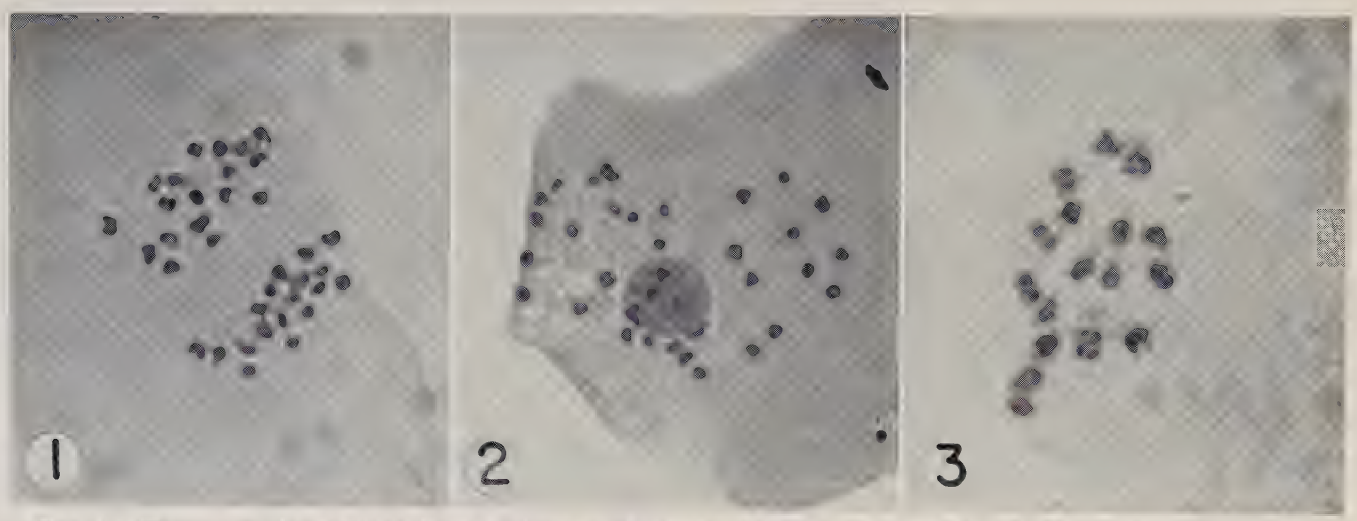
[1] Means and ranges of measurements are given. Measurements were made with a binocular microscope equipped with a micrometer eyepiece.

Living specimens of these three species were secured for cytological studies from the area of the Government Center in Yosemite National Park in July of 1952. The plants were grown in the greenhouses of the Genetics Department of the University of California at Berkeley. Fixations of anther material in 3:1 absolute alcohol—glacial acetic acid were made and chromosome numbers were determined from aceto-carmine squash preparations of pollen mother cells. Voucher specimens of the plants from which cytological materials were secured are preserved in the Herbarium of the University of California at Berkeley.

Gametic chromosome numbers of 18 were found in *S. elmeri* (fig. 1) and 17 in *S. lemmonii* (fig. 3). These are equivalent to the somatic num-



FIGS. 1–3. Chromosome plates of *Stipa*. FIG. 1. *S. elmeri*, anaphase, × 1500 (*Stebbins, Stair and Pohl 7221*), n = 18. FIG. 2. *S. latiglumis*, diakinesis, × 900 (*Stebbins et al 5114–2*), n = 35. FIG. 3. *S. lemmonii*, metaphase I, × 1980 (*Stebbins et al 5117–5*), n = 17.

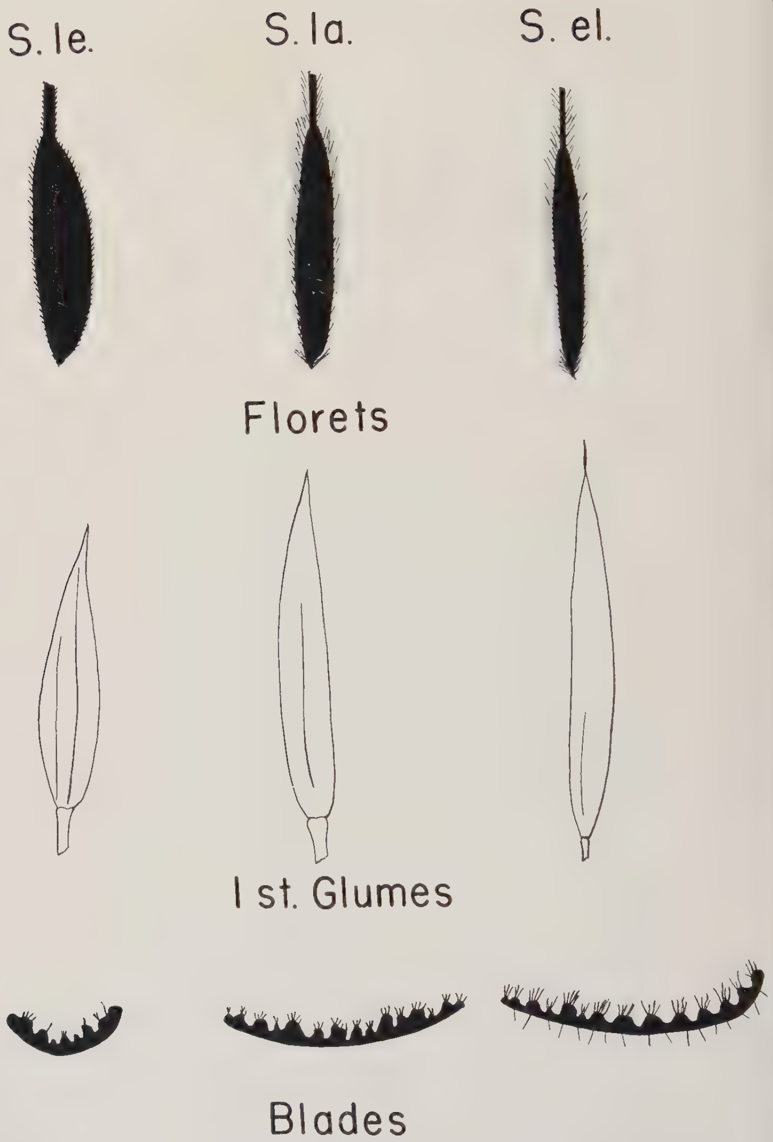


FIG. 4. Florets, first glumes, and leaf cross-sections of *S. lemmonii*, *S. latiglumis*, and *S. elmeri*.

ber of 2n=36 determined for *S. elmeri* and 2n=34 determined for *S. lemmonii* var. *jonesii* by Stebbins and Love (1941). Among the species of *Stipa* found in California, only *S. lepida*, *S. thurberiana*, and *S. lemmonii* var. *jonesii* are known to possess 34 chromosomes in the somatic complement. Neither *S. thurberiana* nor *S. lepida* is known to be present in the Yosemite area, and both differ from *S. latiglumis* in their morphological characteristics and may be excluded as possible parents of the putative hybrid.

The gametic chromosome number of *S. latiglumis* is 35 (fig. 2), equalling the sum of the gametic numbers of the local *S. elmeri* and *S. lemmonii* from Yosemite Valley. Meiotic pairing is apparently regular, although a small number of univalents appear to be present in some preparations. Two chromatin bridges have been observed at anaphase I in a number of sporocytes. Both herbarium specimens and living plants grown at Berkeley bear apparently normal seed.

It appears from the evidence furnished by gross morphology, habitat relationships and chromosome numbers, that *S. latiglumis* is an allopolyploid derivative of *S. elmeri* and *S. lemmonii*. Its fertility, its ability to breed true, and the relatively large size of its parafloral parts, can all be explained by its polyploid nature. Within Yosemite Valley, it appears to be fairly common. Because of the intense Pleistocene glaciation of the Valley, its tenancy there must be post-Pleistocene. It is very probable that it originated there in post-Pleistocene time. The isolated occurrences of this species from Fresno and Riverside counties may represent separate origins of this species from its parents, since each of these localities fall within the coincident ranges of the parental species.

Voucher specimens for chromosome counts. YOSEMITE NATIONAL PARK, CALIFORNIA. *Stipa elmeri*: forested alluvial valley fill below Bridal Veil Falls, October 26, 1952, *Stebbins, Stutz* & *Pohl 7211*. *Stipa latiglumis*: with *S. elmeri* in sandy, somewhat rocky soil in open forest of *Pinus ponderosa* and *Quercus kelloggii,* altitude 4,000 feet, in northwest part of residential area, Government Center, July 7, 1952, *Stebbins, Stutz* & *Zohary 5114–2* and *5114–1*. *S. lemmoni*: dry, rocky talus in shade of *Quercus chrysolepis,* altitude 4,100 feet, along horse trail immediately north of Government Center, July 7, 1952, *Stebbins, Stutz* & *Zohary 5117–5.*

Specimens of *S. latiglumis* examined. CALIFORNIA. Yosemite National Park: Camp Lost Arrow, altitude 4,000–4,500 feet, June 22, 1911, *Abrams 4469* (DS, isotype); Yosemite Valley, *Bolander 6099* (UC, US); Government Center, *Stebbins, Stutz* & *Zohary 5114* (9 specimens) (UC, ISC); same locality and date, *Stebbins et al 5116* (UC); Yosemite Valley, altitude 4,000 feet, June 25, 1911, *Jepson 4280* (US, UC–J). Fresno County: 2.5 miles north of Pinehurst (Sec. 12, T. 14S, R. 27E.), altitude 5,500 feet, July 6, 1944, *Keck 5373* (DS); Dunlop to Millwood, June 6–18, 1903, *Griffiths 4680* (US). Riverside County: Idyllwild, Mount San Jacinto, small erect clumps, sandy pine woods, June 23, 1927, *Swallen 656* (US).

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Grateful acknowledgment is made to Dr. G. L. Stebbins, Jr., who suggested this problem and provided the living plants and facilities used in

this study. The facilities of the Herbarium of the University of California were made available through the kindness of Dr. H. L. Mason, Director. The author wishes to thank the curators of the United States National Herbarium, the Dudley Herbarium, Stanford University, and the Herbarium of the California Academy of Sciences, San Francisco, for the opportunity of studying specimens from these collections.

Ames, Iowa.

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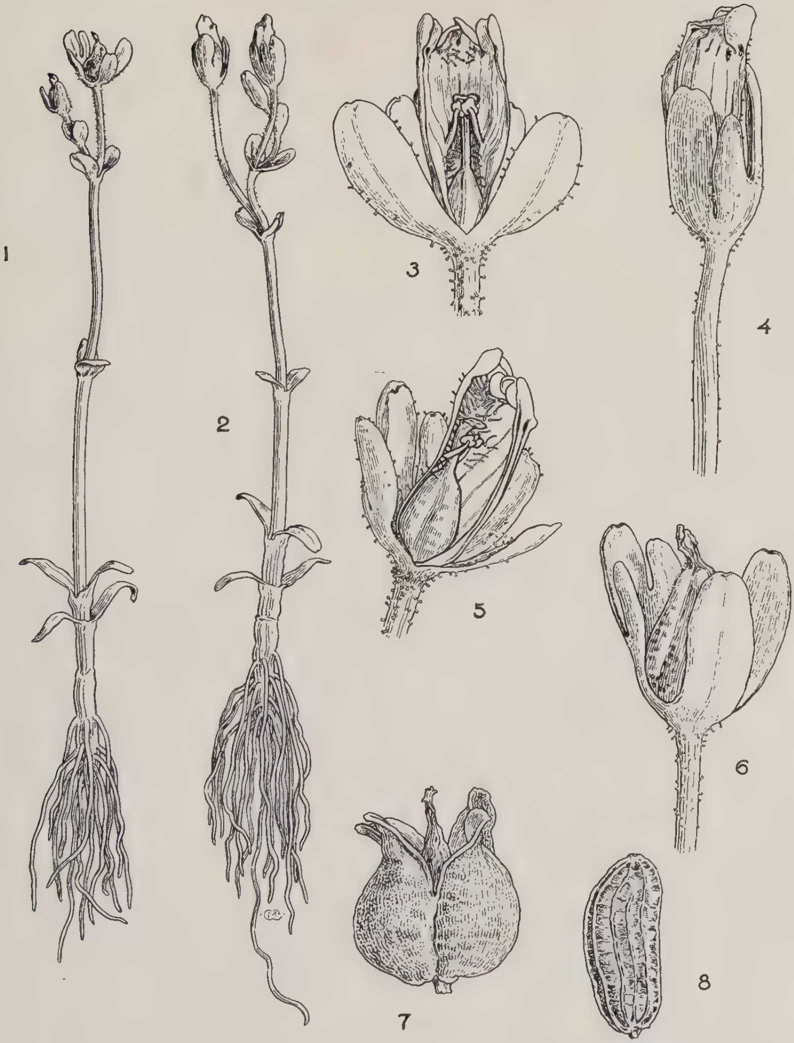
A NEW GRATIOLA FROM BOGGS LAKE, LAKE COUNTY, CALIFORNIA

HERBERT L. MASON AND RIMO BACIGALUPI

In April, 1923, J. W. Blankenship collected material of a species of *Gratiola* which he was unable to identify in the current manuals. He sent specimens to W. L. Jepson for identification. In the Jepson herbarium, the Blankenship specimens represent three collections all labeled "Kelseyville, Lake County." In one of these collections, that of May 21, 1929, Kelseyville is stricken out and "Bogg's Lake" inserted, presumably by Blankenship. Jepson drew up a description and gave the species a manuscript name descriptive of recurved pedicels, a character which in the Blankenship specimens apparently resulted from his failure to press the specimens immediately, for the pedicels are in reality erect. In the Jepson manuscript, there is pencilled the annotation in Jepson's handwriting, "any good?" which attests Jepson's later doubt as to the distinctness of his proposed species. Jepson apparently never saw the plants in the field. This species was rediscovered at Boggs Lake by the writers in 1953. Because of the inappropriateness and misleading character of the Jepson manuscript name, we do not adopt it but propose another.

The plants occur mostly as scattered individuals in the marginal waters of the seasonally receding shoreline of Boggs Lake at the west base of Mount Hanna in Lake County, California, at an elevation of 2900 feet. Often they stand out as single, erect, yellow-flowered individuals in a mass of the coarse, prostrate, white-flowered *Gratiola ebracteata* Benth. In only a few cases were the plants found aggregated in groups of more than one or two individuals. Such groups were in depressions made by the hoofs of cattle and might well reflect the aggregation and pressing into the mud of mature and still filled capsules of the previous season.

Gratiola heterosepala Mason & Bacigalupi sp. nov. A *Gratiola ebracteata* foliis superioribus obtusis nonnumquam emarginatis calyce in-



FIGS. 1–8. *Gratiola heterosepala. 1, 2,* habit, × 1, note glandular hairs in inflorescence; *3,* flower, front view, lower lip removed, × 3; *4,* flower, lateral view, × 3; *5,* flower, side view, × 4; *6,* young capsule, × 3; *7,* capsule, × 5; *8,* seed, × 33. (Drawn from *Mason* & *Bacigalupi 14,544.*)

aequaliter sepalis tribus superioribus connatis fisso corolla aurata labio eius inferiore albo discedit.

Erect amphibious annual herb; stems 2–10 cm. high, stout and fistulose below, slender above, conspicuously striate, glabrous below, pubescent in the inflorescence with glandular-capitate hairs; leaves decussately opposite, lowermost linear-lanceolate, although appearing as though connate, the blade not clasping the stem, 1–2 cm. long, middle leaves much shorter, oblong, the upper obovate, rounded or emarginate, 2–5 mm. long; flowers few on slender erect ebracteate glandular-pubescent pedicels; calyx unequally cleft, the two lower sepals distinct, 4–6 mm. long, oblong, obtuse and emarginate; the three upper sepals joined for one-third of their length or more, the 2 lateral shorter and narrower, the middle lobe broadly oblong, emarginate; corolla tubular, the tube somewhat curved, quadrate, exceeding the calyx, 6–8 mm. long, pilose with gland-tipped hairs externally, a few simple hairs below the stamen-insertion within, 5-lobed, yellow, its lobes 1–2 mm. long, the upper pair of lobes joined nearly to the tip, yellow, the lower three free to the base, white; stamens 2 on short slender filaments, inserted about midway on the tube below the upper pair of petals, the anthers versatile, the sacs slightly unequal; ovary inserted on a thin annular disc, pyriform, 2–3 mm. long, style 1.5–2 mm. long, stigma asymmetrically 2-lobed, the shorter lobe folded against the base of the longer; capsule pyriform, about equaling the persistent calyx; seeds oblong, longitudinally ribbed and with indistinct horizontal ribs.

In shallow water on the southwest margins of Boggs Lake, Lake County, California, *Mason* and *Bacigalupi 14,544,* June 8, 1953 (type, UC 985639; Kelseyville [?]*Blankenship,* April 26, 1923, and May 25, 1929 (JEPS); Boggs Lake, *Blankenship,* May 21, 1929 (JEPS).

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A NEW SPECIES OF HELIOPSIS FROM BAJA CALIFORNIA, MEXICO

T. Richard Fisher

In 1951, a taxonomic study was begun on the genus *Heliopsis* of the Compositae. During the course of this study a previously undescribed species was discovered.

Heliopsis rubra sp. nov. Herba perennis erecta vel ascendens, 50–75 cm. alta; caulis ad basem versus glaber supra, sparse pubescens; folia rhomboideo-deltoidea, integra vel dentibus acutis mucronatis, sparse dentata, 3.5–5.0 cm. lata, 6.5–12.0 cm. longa; petioli hirsuti; capitula 1.0–1.5 cm. lata, 1.0–1.8 cm. alta; involucra 2-seriata, phyllaria adpressa; radii 8–10, aurei; corollae disci flavae; paleae oblongo-lanceolatae rubrae eae senescentes fulvae; radii achenia triangularia, 4.0–5.0 mm. longa, irregulariter tuberculata; achenia disci quadrangularia.

Erect or ascending biennial or perennial herb in mountainous regions, annual in plains regions, 50–75 cm. tall, branched nearly to woody base; stems 0.5–3.5 mm. thick, glabrous below, sparingly pubescent above, previous years' stems glaucous, periderm flaking with age; axils of lateral branches and leaves densely tomentose; internodes 3.5–6.5 cm. long;

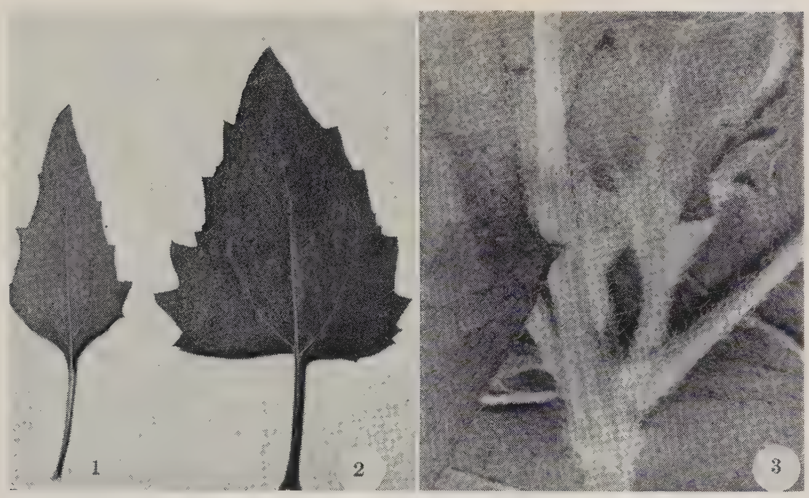

FIG. 1. *Heliopsis parvifolia,* cauline leaf, reduced ½. FIG. 2. *Heliopsis rubra,* cauline leaf, reduced ½. FIG. 3. *Heliopsis rubra,* pubescence of leaf axils, greatly enlarged.

leaves 6.5–12.0 cm. long, 3.5–5.0 cm. wide, firm, light green below, darker green above, petioles slender, 3.5–5.5 cm. long, tomentose, lower surfaces of blades glandular hirsute, densely strigose on the veins, upper surface glandular hirsute, rather scabrous, blades deltoid-rhomboid, apex acuminate, base attenuate to obtuse, margin nearly entire or sparingly dentate, teeth acute and mucronate; heads (excluding rays) 1.0–1.5 cm. wide (in fruit); involucre 2-seriate, phyllaries appressed, the outer unequal, oblong to oblong-lanceolate, apex acuminate to acute, densely velutinous to sericeous on the outer surface extending downward onto the upper limit of the peduncle; the inner phyllaries shorter and more acuminate; rays 8–10, 14–21 cm. long, 6–8 mm. wide, 13–15 nerved, when young yellow below, reddish-orange above, becoming dull yellow with conspicuous greenish, sparingly pubescent nerves below, and golden yellow above at maturity; disk corollas yellowish, lobes sparingly pubescent at the apex, tube 4.0–4.5 mm. long (at anthesis), obtuse; pales lanceolate-oblong to spatulate, glabrous, red at apex when young, becoming brownish-orange with age, membranaceous along the margins, 7.0–7.5 mm. long, 1.5–2.0 mm. wide; ray achenes triangular, outer surface curved, slightly puberulous when young, 4.0–4.5 mm. long, 2–3 nerved, surface irregularly tuberculate; disk achenes quadrangular, sharply so at the apex, rounded at the base, epappose or slightly ridged, faintly nerved on the angles.

Type. Baja California, Mexico: Distrito del Sur, El Pulpito del Arroyo de las Parras, Sierra de la Giganta, lat. 25°58′ N., long. 111°29′ W., north-facing slopes, altitude 250 m., 7 October 1951, *Annetta Carter* and *Louise Kellogg 3158* (UC 924984; isotype deposited at Indiana University).

Additional specimens examined. BAJA CALIFORNIA. Distrito del Norte:

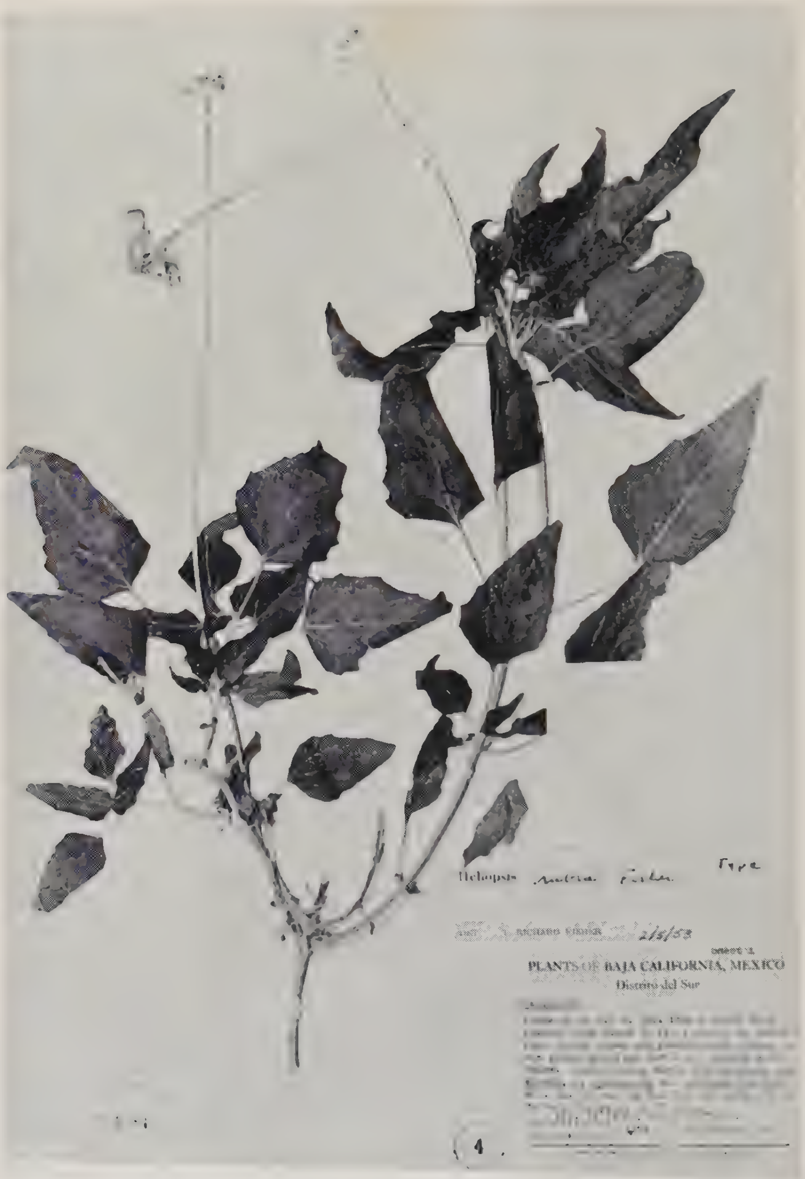
Heliopsis rubra Fisher Type
2/5/53
PLANTS OF BAJA CALIFORNIA, MEXICO
Distrito del Sur
4

FIG. 4. Type specimen of *Heliopsis rubra*.

between Pozo Aleman and Barril, *Wiggins 7841* (GH, MICH, US, UC); east of Pozo Aleman near Calmalli, *Epling* and *Robison s.n.* (UC); near Arroyo Calmalli, *Purpus 221* (UC, F); 4.2 km. south of El Arco, *Carter, Kellogg, Alexander 1925* (UC). Distrito del Sur: near Mesquital Grande, *Haines & Stewart s.n.* (UC); near Tres Virgenes, *Shreve 7049* (MICH); near San Ignacio, *Wiggins 5432* (GH, MICH, US), *Carter, Alexander, Kellogg 1952* (UC), *Shreve 7049* (US); San Aqueda [Santa Aguada], *Palmer 230* (US); San Gregorio, *Brandegee s.n.* (US); Arroyo Hondo, *Carter, Kellogg 2022* (UC); north of San Xavier, *Shreve 6947* (MICH, US), *Wiggins 7748* (US); near Puerto Escondido, *Carter, Kellogg 2866, 2891* (UC); Agua Verde Bay, *Collins, Kearney, Kempton 220* (US); Santa Margarita Island, *Brandegee s.n.* (UC); near Santa Anita, *Nelson & Goldman 7402* (GH, US); near San Jose del Cabo, *Brandegee 309* (UC), *Purpus s.n.* (UC); east of Cabo San Lucas, *Carter, Alexander, Kellogg 2271* (UC).

These collections have, in most instances, previously been identified as *Heliopsis parvifolia* A. Gray, which undoubtedly is the nearest relative of *Heliopsis rubra*. Some of the distinguishing differences between the two species are as follows:

H. parvifolia	*H. rubra*
1. Axils of lateral branches and leaves glabrous or sparingly pubescent.	1. Axils of lateral branches and leaves densely tomentose (fig. 3).
2. Cauline leaves deltoid-lanceolate or rhomboid-lanceolate, approaching deltoid-ovate (fig. 1).	2. Cauline leaves deltoid-rhomboid (fig. 2).
3. Leaf surfaces glabrous to sparingly pubescent.	3. Leaf surfaces strigose.
4. *Apex of the pales yellowish, dull brown at maturity.*	4. *Apex of the pales red, brownish-orange at maturity.*
5. *Achenes* brownish-black, *rugulose*; ray achenes 4.0–5.0 mm.	5. *Achenes* tan to dark brown, irregularly *tuberculate*; ray achenes 7.0–7.5 mm. long.

Heliopsis parvifolia has a general geographic distribution from south-central New Mexico to southeast Arizona, south to the state of Durango, Mexico, and east to the state of Tamaulipas, whereas *H. rubra* is restricted to the peninsula of Baja California.

According to Annetta Carter (correspondence), who has collected in the vicinity of the type locality on several occasions, this *Heliopsis* is more frequent in mountainous areas than on the plains. In the mountains it usually occurs on north-facing slopes or breaks in vertical canyon walls. In years of good late summer rains it may be abundant in full sun on open plains, while in poor years these areas support little or no annual vegetation and may be covered with drifting sand.

An attempt was made in the spring of 1952 to germinate seeds from herbarium specimens (*Carter 1952*), but only one seed germinated. The plant was grown and observed in the research field at Indiana University during the summer. The chromosome number was found to be n = 14, the same as for *H. helianthoides* (L.) Sweet, *H. parvifolia* A. Gray, and *H. annua* Hemsley.

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LODGEPOLE PINE DISCOVERED AND MISNAMED

N. T. Mirov[1]

Lodgepole pine was first collected by Mertens on Sitka Island, Alaska. Here is the story of the discovery of this pine.

Mertens (Alden & Ifft, 1943) was born in Bremen, Germany, in 1796. He studied medicine at the University of Göttingen. In 1824 he left Germany for St. Petersburg, Russia, hoping for a position with Captain Kotzebue's around-the-world expedition. He did not get the job, but went instead to the southern part of Russia where he practiced medicine. Eventually, in 1826, he was appointed as a botanist-zoologist with Captain Lutke's around-the-world expedition sponsored by the Russian Government. Lutke, himself, was a scholar who later headed both the Russian Academy of Sciences and the Imperial Geographic Society. Besides Mertens, Lutke had with him a geologist, Postels, and an ornithologist, Kittlitz.

During the expedition, which covered both the north and the south Pacific, Mertens made an extensive collection of plants—mostly from the tropical parts of the world. He died in St. Petersburg in 1832. Several species and one genus have been named in his honor.

Mertens' collections were turned over to Henri Gustave Bongard who was evidently of French parentage. Bongard was born in 1786, also in Germany (in Bonn). Like Mertens, he was a physician with a degree in surgery received from the University of Vienna in 1810. Later he moved to St. Petersburg, Russia, passed an examination for doctor of medicine, and entered practice, but only to keep body and soul together. Botany had been, since his childhood, his true love. At last, in 1823, he became a professor of botany at the University of St. Petersburg, which position he occupied until his death in 1839. As a taxonomist, Bongard is known by his monographs of Brazilian plants. The genus *Bongardia* is named after him.

When Mertens' Alaskan collection was turned over to Bongard, he found among the 222 collections made at Sitka, many of which were new species, a specimen of a pine which ultimately came to be recognized as *Pinus contorta* Loudon, commonly called lodgepole pine. Bongard, who was brought up in northern Europe where there are only two species of pines for the whole expanse of Northern Eurasia (*Pinus sylvestris* and *P. cembra*), apparently assumed that the eastern American species included in Lambert's monograph (1828) might easily occur in Alaska. Moreover, I suspect from Bongard's description of this Sitka pine that Lambert's beautiful folio with its artistic colored plates, was considered too authoritative to be contradicted. In 1828 Bongard, in a paper on the plants of Sitka Island, misidentified Mertens' Sitka pine as *Pinus inops* Aiton, which is just another name for *P. virginiana*. He was somewhat uneasy, however, about the appearance of the Sitka pine cone, which had "spinae squamarum parum breviores, quam in icone Lamberti laudata."

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[1] Contribution from the California Forest and Range Experiment Station, which is maintained by the Forest Service, United States Department of Agriculture, in cooperation with the University of California, Berkeley, California.

In 1825 David Douglas collected lodgepole pine near the mouth of the Columbia River in Washington, and his specimen was quite properly described by Loudon (1838) as a new species. *Pinus inops* of Bongard (not Aiton) then became correctly known as *P. contorta,* but we should remember that once—for a short time—lodgepole pine was known as *P. inops.*

Berkeley, California.

Literature Cited

Alden, Roland H. and John D. Ifft. 1943. Early naturalists in the Far West. Occas. Papers of the Calif. Acad. Sci., page 38.

Bongard (Henri Gustave). 1833. Observations sur la vegetacion de l'ile de Sitcha. Memoires d'Academie Imperiale des Sciences de St. Petersbourg. 6^{me} Serie, Tome 2. St. Petersbourg, page 163, No. 143.

Lambert, Aylmer Bourke. 1828. A description of the Genus Pinus illustrated with figures, directions relative to the cultivation and remarks on the uses of the several species, etc. Second ed. in two volumes. Vol. 1, p. 21, No. 11. London.

Loudon, J. C. 1838. Arboretum and Fruticetum Britannicum etc. Vol. 4, p. 2292, fig. 2211. London.

REVIEWS

Handbook of Plants of the Colorado Front Range. By William A. Weber. vi + 232 pp., 78 figs. 1953. University of Colorado Press. $5.00.

Both professional and lay botanists have long been in need of a satisfactory guide to the Colorado flora. The standard manuals for the Southern Rocky Mountains are out of print and difficult to obtain. They also are considerably out of date, and difficult for the layman to use. On the other hand, available popular handbooks are so incomplete in their treatment as to be of relatively little value. In this handbook an attempt is made to be sufficiently complete to satisfy the needs of the serious student, and at the same time to make the keys and explanations sufficiently simple to encourage both the beginning student and layman. It is not intended, however, for the use of the professional taxonomist doing critical work.

The author is assistant professor of biology and curator of the herbarium in the University of Colorado. The book developed from a mimeographed key to the Boulder County flora prepared for University of Colorado students. Friends working with the Colorado flora, in desperate need for up-to-date information, encouraged Weber to expand his set of keys to cover the Front Range area. This area includes the eastern slope of the Front Range between Rocky Mountain National Park and Pike's Peak, and ranges in elevation from 5,000 feet to 14,000 feet. Approximately 1,300 species, or almost one half of the total number found in Colorado, occur here. The usefulness of the handbook, however, is extended considerably beyond the limits of the Front Range because of similarity in the flora throughout the mountainous areas of the state.

This handbook was completed several years ago, but financial difficulties prevented immediate publication. The necessity for most authors of regional floras to meet a substantial part of the cost of publication has delayed the appearance of many such books and prevented the publication of several. Dr. Weber fortunately found the solution to this problem in the University of Colorado Press, which is initiating book publication. Nevertheless the book must be reviewed with the realization that many illustrations and much descriptive material had to be omitted purely and simply because of publication costs.

Introductory chapters include simple explanations on the use of keys, and on the recognition of growth forms, floral parts, and leaves. There also are brief discussions of scientific and common names, general vegetation zones in the Front Range area, techniques of plant collecting, and a list of useful reference books. The dichotomous, bracketed keys to the families and to the genera and species are excellent. The reviewer feels that Dr. Weber does an unusually good job in selecting diagnostic morphologic characters in each series. His intimate knowledge of the flora both in the field and herbarium, and his interest in amateur and student viewpoints are evident in his handling of the keys. Detailed descriptions and complete synonymy are omitted and undoubtedly will be missed by some workers. In addition to basic morphologic criteria, however, there are notes concerning relative abundance, habitat, and altitudinal range, and synonymy with the Rocky Mountain manuals is given. General statements are made regarding variation in taxa where hybridization makes it difficult to key individuals satisfactorily. Also species which are doubtfully distinct or probably differentiated into races are indicated. Both scientific and common names are given for families, genera and species, and the meaning of the species name is appended. The index of scientific and common names lists only families and genera. Inclusion of species would have been welcomed by the reviewer. The book is concluded with a well-illustrated glossary. The usefulness of these illustrations maks one deplore the fact that several hundred others had to be omitted from the keys.

"Handbook of Plants of the Colorado Front Range" is a valuable contribution for an audience with a wide range of botanical experience. It should be welcomed by the many persons interested in the Colorado flora who have needed it so greatly.—JEAN LANGENHEIM, Department of Botany, University of California, Berkeley.

Flora of West Virginia (Part II). By P. D. STRAUSBAUGH and EARL L. CORE. West Virginia University Bulletin, Series 53, June, 1953. $1.00.

Part two of this well done and inexpensive local flora series is the first of the two or three proposed fascicles treating those dicotyledonous plants "growing without cultivation" in West Virginia. (Part I of the series — reviewed in the April, 1953, issue of Madroño — treated the Pteridophyta, gymnosperms, and monocotyledons of that state.) Following the sequence used in the last edition of "Gray's Manual," the current fascicle begins with the treatment of the Saururaceae and ends with Leguminosae.

This second installment is of approximately the same size as the first and contains pages 275–570 of the series. The style of the two fascicles is also similar. Thus part two has the same numerous advantages and the same few disadvantages that were noted for part one. In addition to the general advantages of well done local floras, specific advantages of this publication include good descriptive material and diagnostic drawings, and the inclusion of the meaning of all generic and specific names of the taxa treated. The nominal price will make a wide and useful distribution of the books of this series possible and therefore must also be listed as a distinct advantage. As pointed out in the review of part one, the lack of uniformity of drawings, which were taken from different sources, is of minor esthetic importance and in no way detracts from the accuracy or usefulness of the flora. With the publication of part two it is more apparent that the lack of keys to the families in each fascicle as well as the lack of an index for each fascicle is a distinct disadvantage — especially since the book will be used by students and since the last volume, to contain a comprehensive index, may not be out for several more years.

The perennial problem of identification and relationships within the genus *Rubus* appears to be unavoidable, and the authors draw on the recent work of Davis and Davis (The genus *Rubus* in West Virginia. Castanea 18:1–30. 1953) and recognize eighty species of *Rubus* in the area covered. Within this genus even the drawings are of little help and positive identification to the species level will often be rather difficult. Recognition of a smaller number of species, even polymorphic ones, would appear more feasible (at least to one who has never worked with *Rubus* per se!) in such a flora; but this may not come to pass for in their article Davis and Davis (*loc. cit.*) mention some one hundred unidentified *Rubus* collections on hand and say that some of these " . . . will probably necessitate the addition of new species." Perhaps it is fortunate that Strausbaugh and Core got part two of their flora into publication before this further splitting came about.—C. RITCHIE BELL, Botany Department, University of Illinois, Urbana.

Diccionario de Botánica. By P. FONT QUER with the collaboration of eminent specialists. Editorial Labor, S. A. Barcelona. Pp. xl + 1244, 1000 text figures. 1953. $12.80.

Because of the vast amount of information which it contains, Font Quer's "Diccionario de Botánica" might almost be referred to as encyclopedic. In addition to derivations, synonyms, source references, and definitions of terms used in all phases of botany, the treatment of many of the entries includes brief summaries of the subject. The encyclopedic nature of the volume is illustrated by the treatment accorded such words as *formación,* wherein the concepts held by Martius, Kerner, Moss, Clements, and del Villar are summarized; *tanino,* under which three types of tanin are discussed and the formulas given; *simbiosis,* in which a half page is devoted to discussion; and *signo,* wherein five pages are given to signs — from the "shorthand" so frequently used in our early botanical literature to the pictographs of current workers — a much more extensive treatment than is usually encountered. Other significant entries are Lanjouw's abbreviations for the herbaria of the world, found in their proper alphabetical sequence in the main text. These are also grouped geographically in the *Vocabulario Ideológico* following the body of the work.

Forty pages of introduction include discussion of the orthographic matters involved in changing Greek and Latin terms to Castillian, the transition undergone by synonymous terms used from the time of Linnaeus through the Spanish botanists of the 1700's down to the present, and the criteria used in compiling the "Diccionario."

The taxonomic nomenclature adopted is in accord with the decisions of the International Botanical Congress. Terms relative to taxonomy were taken from the eleventh edition of the "Syllabus der Pflanzenfamilien." Plant names below the level of family (genera, species, etc.) are not included as entries in the dictionary, but under discussion of each family the most important genera have been listed. In the discussion of criteria for exclusion and inclusion of terms (pp. xxxiii, xxxiv), it is explained that alphabetical entry of all genera would have made the work much too bulky. This aspect of botanical reference literature is adequately handled by Willis in his "Dictionary of the Flowering Plants and Ferns."

The treatment of synonymous terms deserves some mention. A preferred term is given full treatment, but various synonyms are listed in proper alphabetical sequence and allotted only sufficient space for derivation and a brief definition. Synonymous terms are referred to the preferable term but not to each other.

Following the main section of the dictionary, a supplement of eleven pages of additional terms indicates the care which was taken to bring the completed work as nearly up to date as possible. Errors which inevitably creep into such an extensive work as this are cared for by the three pages of errata inserted in the introductory pages. An interesting and useful feature of the dictionary is the *Vocabulario Ideológico,* wherein the principal terms treated in the main body of the dictionary are grouped according to the nineteen aspects of botany in which they are most commonly used. Under numerous sub-categories here are listed the technical words that one would expect to find in the discussion of such items as protoplasm, climate and microclimates, or pteridophytes. The final eight pages of the volume are devoted to selected bibliographical references used in the compilation of the dictionary.

The dictionary is abundantly illustrated with clear line drawings, many of them original. Others are those with which we have long been familiar, e.g. the *formas biológicas* of Raunkiaer, or the flowers characterizing various families as portrayed in Wettstein. As to typography, the dictionary is printed in very legible eight point type. It is attractively bound in quarter leather, and the excellence of the workmanship is attested to by the ease with which the book lies open at any page.

There is nothing in English comparable to Font Quer's work; Jackson's "Glossary of Botanic Terms" comes the closest. Even though many of us may not feel at home with the Spanish language, we will find this "Diccionario de Botánica" an extremely valuable botanical reference work. Dr. Font Quer and his eight principal collaborators are to be congratulated on the publication of this volume.—ANNETTA CARTER, Department of Botany, University of California, Berkeley.

NOTES AND NEWS

RANDOM OBSERVATIONS IN THE HIGH SIERRA OF YOSEMITE NATIONAL PARK, CALIFORNIA. Plants of *Lewisia disepala* Rydberg growing in granitic sands at 8000 feet elevation on Mount Watkins closed their petals about noon whether the day were bright or overcast. Cross pollination of *Polemonium californicum* Eastwood seems assured by the fact that after the sepals have opened, the petals for a time remain closed, clasping the well-exserted stigma. Plants exhibiting this behaviour were noted during the summer of 1953 at May Lake between elevations of 8600 and 9000 feet.—H. L. BUCKALEW, Fresno, California.

The editors of Madroño feel that an explanation for the appearance and late publication date of the October number of the Journal is in order. During its composition, the printer then doing our work went into bankruptcy. In this emergency our Assistant Business Manager performed yeoman service and obtained the services of a nearby printer who salvaged type and manuscript. Not being experienced with scientific publication, this new printer proceeded with the final copy without presenting second proofs to the editor. Under the circumstances, it seemed best to include an errata slip in the issue rather than penalize the printer by asking him to reprint a job which was undertaken in part as a gesture of good will. We therefore ask the indulgence of our readers.

With the present number, we have placed Madroño in the hands of Gillick Press in Berkeley, and we are looking forward to the publication of a journal with a high quality of printing.—H.L.M.

On January 21, 1954, at the regular monthly meeting of the California Botanical Society, the following persons were elected as officers: President: N. T. Mirov; First Vice-president: William Hiesey; Second Vice-president: Harlan Lewis; Recording Secretary: Mary L. Bowerman; Corresponding Secretary: G. Thomas Robbins; Treasurer: Richard W. Holm.

Some publications of interest follow:

Karok Ethnobotany, by Sara M. Schenck and E. W. Gifford. Anthropological Records 13(6):377–392. 1952. University of California Press. The Karok territory extends along the Klamath River from above Bluff Creek, Humboldt County, to above Happy Camp, Siskiyou County, California.

A Revision of the North American Species of Lathyrus, by C. Leo Hitchcock. University of Washington Publications in Biology 15:1–104, 9 pls., 10 maps, 2 charts. 1952. $2.50.

Drawings of British Plants, by Stella Ross-Craig. Part V. Caryophyllaceae, 66 pls. 1951. Part VI, Portulacaceae through Aceraceae, 56 pls. 1952. G. Bell and Sons, Ltd. Each part 10s. net.

Nuttall's Travels into the Old Northwest, an unpublished 1810 Diary, by Jeanette E. Graustein. Chronica Botanica, Vol. 14, No. 1/2. 1950–51. $3.00.

Artemisia, section Seriphidium, in North America, a cytotaxonomic study, by George H. Ward. Contributions from the Dudley Herbarium, Volume 4, Part 6, 1953. Stanford University, Stanford, California.